Title of the Invention

DATA MIGRATION METHOD FOR DISK APPRATUS

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a computer system and a method for controlling interface commands of a disk apparatus for online data migration technology of the disk apparatus and, more particularly, to migration technology for the contents of the disk apparatus for storing task process data while a host computer continues to process task data.

2. Description of the Related Art

Conventionally, in the case of updating a newly connected disk apparatus (new disk apparatus) from a disk apparatus (old disk apparatus or migration source disk apparatus) functioning as an outside storage device, in order to utilize continuously data that are processed up to now, data of the old disk apparatus shall be moved to the new disk apparatus (migration). In such a case, as a conventional general method, a method of storing the contents of the current disk apparatus once in a backup file of a tape unit or the like and then restoring after the disk apparatus was exchanged has been employed. Otherwise, there has been

known a method for connecting the new disk apparatus, as well as a conventional old disk, to a host computer and then storing copy data of the old disk apparatus in the new disk apparatus by the host computer. Here, these methods stop the tasks of the host computer for a long period of time. Operation for stopping tasks for such a long period of time cannot be accepted as the tasks of the most modern data center characterizing non-stop operation.

For a method for improving such a condition, a patent document 1 (Japanese published unexamined patent application No. 2001-249853) discloses a method for executing data migration from the old disk apparatus to the new disk apparatus by connecting the new disk apparatus to a switch provided between the host computer and the old disk apparatus. According to this data migration method, a unit for copying data from the old disk apparatus to the new disk apparatus while the disk apparatus of the host computer is continuously accessed is provided in the switch (or a storage system). However, in this data migration method, the old disk apparatus and the host computer that is used are necessarily disconnected for a while and then the switch having the above cited online data migration function shall be provided. Here, if the number of access paths between the host computer and the old disk apparatus is one, the computer system shall be halted.

For another method, a patent document 2 (Japanese

published unexamined patent application No. 11-184641) discloses a method for executing data migration without stopping while plural access paths are included between the host computer and the disk apparatus and at least one access path is continuously maintained. This data migration method is made and used by a changing-over path function provided on the host computer, i.e., a method for changing-over access paths dynamically by managing two or more access paths between the host computer and the disk apparatus on the host computer. The changing-over path function of the host computer, however, may not work properly for a disk apparatus having different interface specification as a process task of a specified disk apparatus. The reason is because a SCSI response of the disk apparatus is utilized inherently in order to identify automatically plural access paths for the disk apparatus (referred to a logical unit in the SCSI code). Namely, for such a response, there may be caused a problem in which access is denied if consistency is not recognized in disk inherent information for an interface command.

[Patent document 1]

Japanese published unexamined patent application No. 2001-249853

[Patent document 2]

Japanese published unexamined patent application No. 11-184641

Brief Summary of the Invention

In the above cited conventional technology, at the time of changing-over an old disk apparatus to a new disk apparatus, since consistency between old disk (apparatus) inherent information maintained by a host computer as configuration information and new disk (apparatus) inherent information is not firmly assured, the host computer closes an access path by judging that the new disk apparatus fails due to this inconsistency, thus a problem in which the computer system goes down is caused as a result.

The object of the present invention is to provide interface command control technology (control system and computer system) of data migration of the disk apparatus capable of executing non-stop data migration without requiring stop operation of accessing the disk apparatus by the host computer due to the above cited inconsistency in accordance with data migration procedures from old disk apparatus to the new disk apparatus.

Another object of the present invention is to provide interface command control technology for data migration capable of updating (exchanging) a differently specified disk apparatus by avoiding causing failure due to a disk inherent information change in accordance with migration from the old disk apparatus to the new disk apparatus.

Another object of the present invention is to provide interface command control technology for data

migration of a computer system having high availability and maintaining redundancy of the access path by performing correctly an alternate path function during and after data migration.

Still another object of the present invention is to provide interface command control technology for data migration of the disk apparatus capable of executing data migration smoothly without stopping migration for the disk apparatus shared by plural host computers.

Still another object of the present invention is to provide the computer system adapting the interface command control method of the above cited disk apparatus.

In order to solve the above cited objects, the present invention, in a method for controlling an interface command of a magnetic disk apparatus of a computer system including one or more host computers, a disk apparatus (old disk apparatus) connected prior to the host computers, and a disk apparatus (new disk apparatus) newly connected to the host computers via a switch, includes the steps of changing-over and connecting the old disk apparatus to the host computers via the switch being connected to the new disk apparatus, executing data migration from the old disk apparatus to the new disk apparatus via the switch, identifying a command for inquiring disk identification as an interface command from the host computers and a

command for inputting and outputting data, and sending the command for inquiring the disk identification to the old disk apparatus.

Further, data migration from the old disk apparatus to the new disk apparatus is executed by an online data migration function of the switch.

Furthermore, the old disk apparatus and the new disk apparatus operate by a SCSI command from one or more host computers, and a SCSI command utilized by the host computers for identifying the disk apparatus exchanges data so as to utilize as the same disk apparatus before and after data migration.

Furthermore, one or more host computers share at least one old disk apparatus, and the old disk apparatus is reused for storing data after data migration.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more apparent from the detailed description taken in conjunction with the accompanying drawings and thus are not limited to the present invention in which:

FIG. 1 is a block diagram of a computer system for explaining data migration embodiment of the present invention;

FIG. 2 exemplifies process of inserting a switch of the present invention between a host computer and an old disk apparatus;

FIG. 3 exemplifies a data flow during online data

migration process of the present invention;

FIG. 4 exemplifies a data flow after online data migration process of the present invention;

FIG. 5 is a flowchart for explaining data migration process of the present invention;

FIG. 6 is a flowchart for explaining operational procedures of connecting the old disk apparatus of the present invention to the switch;

FIG. 7 is a SCSI command kind table;

FIG. 8 is a flowchart for identifying whether a SCSI command from the host computer of the present invention is "disk inherency" or not; and

FIG. 9 is a block diagram of disk apparatuses of the computer system of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following part, a computer system and an interface command control method of a disk apparatus of the present invention are explained with reference to the embodiments of the present invention of FIGS. 1 to 9.

(1) Computer system diagram

FIG. 1A exemplifies a computer system diagram before data migration. The host computer 1 is connected to an old disk apparatus 2 via access paths 3 and 4. The access paths 3 and 4 are fiber channels or parallel SCSI based on the SCSI standard.

FIG. 1B exemplifies a computer system diagram after migration. A switch 5 is connected to the host

computer 1 via access paths 3a and 4a and the old disk apparatus 2 via access paths 3b and 4b. The access paths 3a and 4a and the access paths 3b and 4b are fiber channels and the parallel SCSI based on the SCSI standard. These access paths 3a and 4a and access paths 3b and 4b are access paths after switching connection.

Further, the switch 5 is connected to a new disk apparatus 6 via access paths 7 and 8. The access paths 7 and 8 are fiber channels or the parallel SCSI based on the SCSI standard. Here, the number of host computers shall not be limited by the present invention, when this invention is made and used, since the present invention is data migration from the old disk apparatus 2 to the new disk apparatus 6.

A host interface control part 9 is connected to the access paths 3a and 4a via ports 15 and 16 and controls SCSI command transmitting to and receiving from the host computer 1. Further, the host interface control part 9 is connected to disk interface control parts 13 and 14 and a reserve emulation part 10 via internal paths 21, 29, and 22 respectively.

A disk interface control part 13 is connected to the access paths 3b and 4b via ports 17 and 18, and controls SCSI command transmitting to and receiving from the old disk apparatus 2. Further, a disk interface control part 13 is connected to the reserve emulation part 10, a SCSI command control part 11, and an online data migration part 12 via internal paths 23,

25, and 27 respectively.

A disk interface control part 14 is connected to the access paths 7 and 8 via ports 19 and 20 and controls SCSI command transmitting to and receiving from the new disk apparatus 6. Further, the disk interface control part 14 is connected to the SCSI command control part 11 and the online data migration part 12 via internal paths 26 and 28 respectively.

The reserve emulation part 10 receives SCSI commands, which are issued by the host computer 1, from the host interface control part 9 via an internal path 22 and executes exclusive access control to access from the host computer in accordance with the SCSI commands with regard to reserve and release (the number of host computers to be connected is not limited, although one host computer 1 is indicated in FIG. 1B).

The SCSI command control part 11 receives the SCSI commands from the host computer 1 via the host interface control part 9 and the reserve emulation part 10, and gives the SCSI commands to the old disk apparatus 2 and the new disk apparatus 6 via the disk interface control part 13 and the disk interface control part 14. Further, response information from the old disk apparatus 2 and the new disk apparatus 6 is given to the host computer 1 via the paths in reverse. The SCSI command control part 11 has the function of classifying the SCSI commands from the host computer 1 and giving them to the old disk apparatus 2 or the new

disk apparatus 6. The operation therefor is explained hereinafter with reference to FIGS. 3 and 4.

The online data migration part 12 of FIG. 1B has the function of copying automatically data stored in the disk apparatus, reads data via the disk interface control part 13 from the old disk apparatus 2, and writes data via the disk interface control part 14 in the new disk apparatus 6, when data migration is executed.

(2) Interface command control procedure for data migration

An example of data migration process of the computer system of FIG. 1 is explained using flowcharts of FIGS. 5 and 6. FIG. 5 indicates process in which data migration is executed in an order of steps 51, 52, 53, 54, and 55. They are expressed as (step 51), (step 52), ..., and (step 55) in the latter part of the description. Further, FIG. 6 indicates operator's operational procedures 61 to 64 which are executed at the step 52 of FIG. 5.

Before starting data migration, as shown in FIG. 1A, the host computer 1 accesses the old disk apparatus 2 using the access paths 3 and 4. First of all, the operator operates the system so as to connect the new disk apparatus 6 to the switch 5 via the access paths 7 and 8 (step 51).

Next, in order to connect the old disk apparatus 2 to the switch 5, the system is operated in accordance

with the procedures 61 to 64 of FIG. 6 (step 52). The operator changes-over and connects the access path 4 to new access paths 4a and 4b (the procedure 61 of step 52). At this time, the host computer 1 detects changing-over of the access path 4, makes the access path 4 to an offline state, and continues to access the old disk apparatus 2 using the access path 3. Next, the host computer 1 is operated so as to make the access path 4a to an online state (the procedure 62 of step 52).

FIG. 2 indicates the condition of this case. The host computer 1 and the old disk apparatus 2 are connected logically using SCSI data paths 30 and 31. Next, the access path 3 is changed-over and connected to the new access paths 3a and 3b (the procedure 63 of step 52). Next, the host computer 1 is operated so as to make the access path 3a to the online state (the procedure 64 of step 52). Accordingly, the host computer 1, the switch 5, and the old disk apparatus 2 are connected as indicated in FIG. 1B, and the host computer 1 accesses the old disk apparatus 2 via the switch 5.

Next, in step 53 of FIG. 5, process in relation to SCSI reserve migrates to the reserve emulation part 10 from the old disk apparatus 2. To be more precise, the reserve emulation part 10 accesses the old disk apparatus 2 via an internal path 23, checks the reserve condition of the old disk apparatus 2, sets its

condition as an initial condition of the reserve emulation part 10, and then releases a reserve condition of the old disk apparatus 2. Then, process of SCSI commands with regard to reserve such as release and reserve received from the host computer and process of controlling access from another host computer (another initiator) for a disk apparatus are executed in the reserve emulation part 10. The reserve condition of the old disk apparatus in the process of this step 53 shall be released before online data migration (step 54) execution. Because, there may be caused trouble condition for a process of reading data from the old disk apparatus 2 when online data migration is executed for the condition in which the old disk apparatus 2 is reserved by a reserve command from the host computer. Therefore, the old disk apparatus can be accessed without reserving by including the reserve emulation part 10 in the upper portion of an online data migration part 12.

Next, the online data migration part 12 copies data from the old disk apparatus 2 to the new disk apparatus 6 (step 54). Here, with reference to FIG. 3, a typical data flow during data migration is explained. The host computer 1 and the old disk apparatus 2 are connected logically via a SCSI data path 32, and the old disk apparatus 2 is continuously accessed from the host computer 1. Further, on a parallel with this case, the online data migration part 12 copies data from the

old disk apparatus 2 to the new disk apparatus 6 as indicated in a path 33 of SCSI data.

Next, when online data migration process is completed, the SCSI command control part 11 changes-over SCSI commands, with regard to disk read and write, issued by the host computer 1 to the new disk apparatus 6 (step 55). Here, with reference to FIG. 4, a typical data flow is explained after data migration. As indicated by a SCSI data path 35 of FIG. 4, SCSI commands, with regard to write and read, issued by the host computer 1 is given to the new disk apparatus 6 via the disk interface control part 14 and an internal path 26 from the SCSI command control part 11. The SCSI commands, with regard to write and read, issued by the host computer 1 are not issued to the old disk apparatus 2.

The SCSI command control part 11 identifies SCSI commands for identifying the disk apparatuses issued by the host computer 1, i.e., inquiry commands and SCSI commands in relation to mode sense series not specified in the SCSI standard specification, and issues them continuously to the old disk apparatus 2 (SCSI data path 32 of FIG. 4). Accordingly, although process in relation to actual read and write operations is executed in the new disk apparatus 6, data migration can be completed without stopping since the host computer 1 recognizes that the old disk apparatus 2 is continuously connected.

If suchlike data migration is executed by plural host computers, the old magnetic disk apparatus is shared by plural host computers. Further, if plural old magnetic disk apparatuses are connected, plural magnetic disk apparatuses are shared.

FIG. 7 is a SCSI command kind table. In this table, SCSI commands for SCSI command names "Inquiry" (operation codes 12_H) and "Mode Sense" (operation codes $1A_H$) series not specified in the SCSI standard specification are command kinds which shall be set in the disk apparatus inherently. For accessing data after data migration between magnetic disk apparatuses, there has been anxiety in which data access might be negatived after migration by recognizing suchlike command kind inconsistency as disk exchange information disagreement by the host computer. However, in accordance with the computer system and an interface command control method of the present invention, it was recognized that suchlike inconsistent recognition was avoided and data access after migration was executed steadily.

FIG. 8 indicates specific procedures for a method of controlling interface commands of the present invention for avoiding this inconsistent recognition.

FIG. 9 illustrates a condition in which inherent information is stored as memory, which corresponds to each command kind set in the inherent magnetic disk apparatus of the computer system of the present

invention.

In the above mentioned example, the case of utilizing the switch 5 for data migration is explained. The present invention is not limited to this case, but it is also applicable to execute data migration by utilizing the disk apparatus or disk controller (generic term of portions including a disk control part 205, CPU 204, a port control part 203, a memory 202, and inherent information 201 of the old disk apparatus of FIG. 9).

As explained in the above cited, the present invention does not need an access stop to the disk apparatus from the host computer for data migration procedures from the old disk apparatus to the new disk apparatus, and thus non-stop data migration can be made.

Further, fault condition caused by disk apparatus inherent information change when data migration is executed from the old disk apparatus to the new disk apparatus can be avoided and thus the disk apparatus having inconsistent specification can be exchanged without any stopping.

Further, redundancy of access paths among the host computer, the switch, and the disk apparatus can be maintained and thus highly available computer system data migration and operational availability after data migration can be made.

Further, complete non-stop system migration can be made by including the function of simulating reserve

process even for the disk apparatus shared by plural host computers.

In this way, the invention is explained concretely based on the embodiments invented by the inventor. The present invention is not limited to the above cited embodiments, but it goes without saying that various modifications can be applied within the scope of the gist of the present invention.

Although data migration has been exemplified as the function of the switch, for example, this data migration can also be applied widely to a disk array (RAID) subsystem including the equivalent function. Further, the old disk apparatus after data migration can be diverted to data storage used by the switch and the disk array sub system.

According to the data migration method of the disk apparatus of the present invention, since the host computer recognizes that the old disk has been connected even during or after executing data migration to the new disk apparatus from the old disk apparatus, effects, in which the host computer does not need to change the definition of the disk apparatus and then tasks on the host computer can be performed continuously, are obtained.

Further, in a system in which the host computer is connected to the old disk apparatus via plural redundant access paths, since the host computer can access the disk apparatus without stopping when data

migrate and the host computer can also utilize plural access paths continuously after data migration, effects, in which data migration can be executed without stopping access and protection against the fault of access paths can be maintained, are obtained.

Furthermore, in a cluster system in which plural hosts share the old disk, the effect in which non-stop data can migrate smoothly while the cluster is maintained since exclusion information of the disk apparatus also migrates is obtained.

Furthermore, after data migration, the effect in which the old disk can be diverted to the device for storing other data is obtained.